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ABSTRACT

The summer meeting of the Business-Higher Education Forum continued the dialogue between the education and business communities on subjects important to all. Welcoming remarks by chairman Dennis Smith set the tone for the meeting and introduced the panel presentations that followed. The panel presentations, summarized in this report, were: (1) "Responding to the Crisis in Nursing"; (2) "How Students Are Paying for Their Education"; (3) "University Outcomes and the Workplace"; (4) "Regional Economic Development"; (5) "Executive Committee Report"; (6) "Learning and Technology Initiative--Next Steps"; (7) "Math and Science Educatio--Toward a Systemic National Leadership Program"; and (8) "Concluding Remarks and Next Steps." (SLD)

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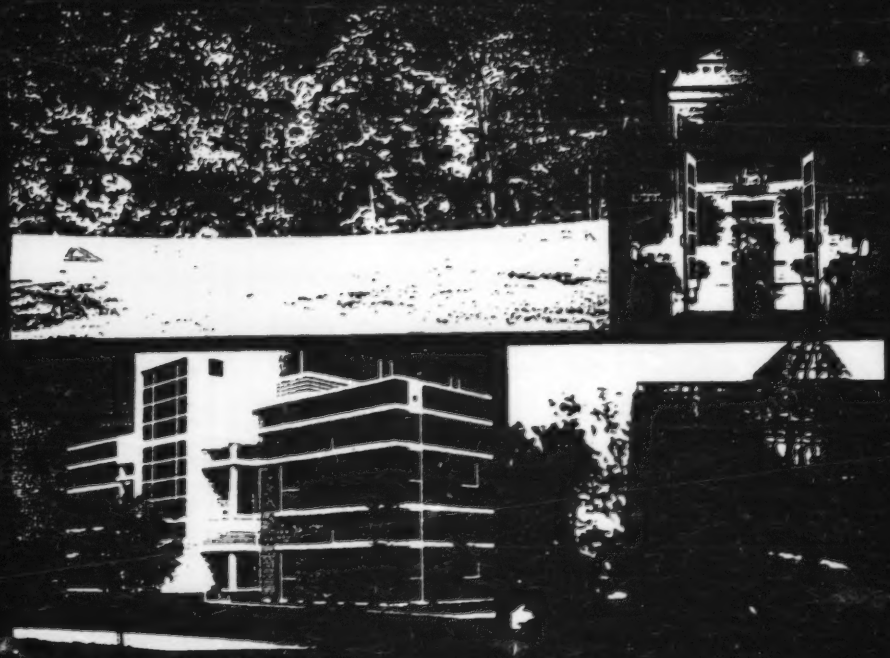
BUSINESS-HIGHER EDUCATION FORUM

ForumFocus

Report of the Summer 2002 Meeting of the
BUSINESS-HIGHER EDUCATION FORUM

Chapel Hill, North Carolina
June 6–8, 2002



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August 2002

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Table of Contents:

Chairman's Welcoming Remarks 4

Panel Presentations:

- Responding to the Crisis in Nursing 5
- How Students Are Paying for Their Education 10
- University Outcomes and the Workplace 17
- Regional Economic Development 20
- Executive Committee Report 26
- Learning and Technology Initiative—Next Steps 27
- Math and Science Education—Toward a Systemic National Leadership Program 29
- Concluding Remarks and Next Steps 39

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Chairman's Letter

Those unable to attend the Summer Meeting missed a particularly rich dialogue between the education and business communities on subjects important to all of us. I want to repeat my thanks to Molly Broad and Bob Ingram for helping us meet in a region that personifies cooperation between business and education. My thanks, too, to Jerry Murphy and his staff for providing excellent meeting planning and support.

The entire organization owes Dennis Smith a debt of gratitude for his leadership during the past two years. I'm honored to follow in his footsteps as we build on the considerable strengths that member universities, businesses, military services, and museums bring to the Forum as we address current and future challenges.

The Forum's strength is in its membership. I look forward to working together to help shape national opinion on the vital issues challenging our educational system.

I closed my end-of-meeting comments in Chapel Hill with an unattributed quote: "The best way to predict the future is to invent it." That comment first came, I believe, from someone who knows something about inventing the future—personal computer pioneer Alan Kay.

I hope you'll reserve January 30 through February 1, 2003, when we'll have another opportunity to work together—in the wintertime warmth of San Diego—to help shape the future.

Edward B. Rust

Edward B. Rust
2002–2004 Forum Chairman

Chairman's Welcoming Remarks

Co-hosted by **Molly Broad** (President, University of North Carolina) and **Bob Ingram** (COO and President, Pharmaceutical Operations, GlaxoSmithKline), the Forum's Summer 2002 Meeting took place in Chapel Hill, North Carolina. The Forum held the first two sessions respectively at GlaxoSmithKline and at the Centennial Campus of North Carolina State University.

Forum Chairman L. Dennis Smith (President, University of Nebraska) opened the meeting by thanking the co-hosts for their hospitality. He invited Bob Ingram to address the Forum. Ingram welcomed members to GlaxoSmithKline and introduced Tim Tyson (Vice President, Global Manufacturing and Supplies Operations, GlaxoSmithKline) as the speaker on the Regional Economic Development panel. Ingram gave a brief overview of the company's history. Dedicated in 1990, the company's facility represented the largest capital investment—$1.5 billion—in North Carolina's history and is currently the largest U.S. research site. Ingram explained that Glaxo, the heritage company of GlaxoSmithKline, began in North Carolina in 1978, with its original facilities being two rented chemistry laboratories on the University of North Carolina (UNC) campus. Becoming both neighbors and partners with academe was the reason the company decided to settle in the Research Triangle Park (RTP), Ingram said. He lauded the ongoing partnership programs in science and education, as well as community efforts with academe, saying that the company was committed to continually building on the partnership, despite budgetary constraints.

Dennis Smith

Ingram closed by emphasizing that the state legislature needs to understand the importance of investing in education and human capital.

Chairman Smith concluded his remarks by reminding Forum members that the meeting represented the end of his two-year chairmanship and that he would later pass the baton to Ed Rust (Chairman and CEO, State Farm Insurance). Smith thanked the two preceding chairs, Dennis O'Connor (Under Secretary for Science, The Smithsonian Institution) and Hank McKinnell (Chairman of the Board and CEO, Pfizer Inc). Chairman Smith underscored that the Forum was in a strong, healthy state, with a membership of 75 (29 corporate members, 42 academic members, and four museum and government members).

Molly Broad

Bob Ingram

PANEL PRESENTATIONS

Responding to the Crisis in Nursing

Dennis O'Connor (Under Secretary for Science, The Smithsonian Institution*) moderated the session.

At the Winter 2002 Meeting in Scottsdale, Arizona, the Forum conducted panel presentations on "Nursing Shortages, Shortfalls, and Shaping the Future." Pursuant to these presentations, Forum members agreed to address the nursing and health care issue at the Summer 2002 Meeting in Chapel Hill. The Forum created a working group chaired by Dennis O'Connor to take a more in-depth look at the issue of shortages in the nursing profession, to see how it related to concerns of the Forum membership.

O'Connor referred to a *New York Times* article (May 28, 2002), which reported that hospitals today need up to 126,000 nurses (source: AHA, Advancing Health in America, Estimated U.S. Hospital Vacancies, Selected Job Categories, 2001). He highlighted that with the coverage received in the news, the issue was clearly one of national concern.

O'Connor outlined four topics for the panel presentations:

- The design and practice of nursing care.
- The educational requirements for nurses.
- The image of the nursing profession.
- The workplace environment as its affects health care and nursing care delivery.

He introduced the speakers and gave a brief overview of their backgrounds.

Geraldine Bednash (Executive Director, American Association of Colleges of Nursing) gave an overview of how nursing education affects and is affected by the nursing shortage. Building on a presentation given by Dr. Bette Keltner (Dean, Georgetown University School of Nursing) at the Forum's Winter 2002 Meeting, during which she presented the demographics of an aging and interest-declining profession, Bednash outlined the objectives of the panel presentations: (1) provide additional information on the nature of the shortage and its impact on both patient care and the costs of health care, and (2) set a framework for a new mental image of the nursing profession. She emphasized the importance of a dialogue with Forum members to define a framework for action that would bring together the business and higher education sectors in addressing the health care delivery issue in the United States.

Geraldine Bednash

The current shortage in the nursing profession can be attributed to several factors: the aging workforce (the aging of the Registered Nurse [RN] population is occurring four times faster than in other fields), a decline in interest in the profession since the 1970s, and a dramatic increase in retirement numbers. Bednash described the current shortage as a hospital-based phenomenon, with hospitals offering incentives such as bonuses and modified work plans to attract RN professionals. She further described the current hospital settings as increasingly complex, providing care to the sickest patients only. Bednash noted that almost 75 percent of all surgeries are done on an outpatient basis, with no hospital admission, and only the most complex surgeries are done in a hospital. Home health care also is a norm for monitoring patients, and hospitals admit only those individuals with the most complex needs. These are the patients who will most likely suffer multiple chronic conditions, be treated with a range of sophisticated technological tools, and receive a complex array of pharmacological agents as part of their treatment. In these settings,

*Titles and affiliations reflect positions held at the time of the meeting.

nurses are the primary surveillance system, Bednash underscored, interacting with and coordinating the care of multiple providers who pass through these settings for short durations. She pointed out that according to the Joint Commission on Accreditation of Health Care Organizations, nurses were involved in 24 percent of "sentinel events," or events in which surveillance system failures caused serious or negative events during the course of patient care.

Bednash further described the state of the profession by highlighting additional data:

- Potential students do not see the profession as intellectually stimulating or professionally rewarding—students do not consider nursing a valued profession that could result in a role as a valued part of the health care team.
- Enrollments and graduations declined in the last five years, with a small increase of 3.7 percent reported in 2001, but the number of individuals sitting for the national license exam has declined by 30 percent since 1997.
- Faculty shortages are a major factor in the non-admission of qualified baccalaureate applicants into a program.
- Nursing schools are struggling to compete with the practice environments that can offer salaries far beyond those available in a nursing program.
- The average age of full professors is 56 and, of greater concern, that of assistant professors is 50.
- The nursing profession is a predominantly white and female profession—educators in the field are working hard to attract a more diverse population, in terms of race and ethnicity as well as gender, to the nursing profession.

Bednash concluded by pointing out that in order to ensure that college-entering students consider the nursing profession as a career, higher education administrators must address the concerns that have shaped the nurses' experience in health care. These concerns include the need to pursue a career that represents a respected place in the health care community, the need for salaries commensurate with the education and responsibilities that the professionals acquire, and the need for a seat at the decision-making table in both the practice and the education environments.

Lauren Arnold (Senior Director, Operations Analyst, Tenet Healthcare Corporation) spoke about the impact of the nursing shortage on the health care industry, on patient care, on businesses that support health care costs, and on society at large. The fact that nursing care services today are delivered in the same manner as when nursing care was first designed to provide hospital services almost 50 years ago has serious consequences in today's dramatically different environment, Arnold explained. She divided her presentation into four areas in which the nursing shortage has a serious impact: access to care, the quality of care and service, the cost of care, and medical research.

Lauren Arnold

Overview

Changes in the environment in which nursing care is practiced include an aging patient population and increases in chronic and acute conditions, which require nurses at the bedside to make critical decisions to integrate complicated sets of data, to make treatment decisions, and to collaborate with physicians around treatment paradigms. Arnold continued by naming the issues that represent dramatic changes in the nursing care environment—changes that must be considered to change the way hospital care is delivered:

- The complexity of treatment protocols.
- Acuity compression in hospitals. It is projected that in the near future, hospitals will consist pr dominantly of critical care units.
- Escalating customer service expectations—the baby-boomer generation expects high-quality service at all times.

Arnold described the way the nursing profession is perceived, highlighting the fact that it serves as the backbone of the health care industry, covering all stages of life. The nursing profession supports every aspect of the health care industry sector—community settings, hospitals, emergency rooms, home care, outpatient centers—with a role in prevention, treatment, rehabilitation, and health education forums. However, Arnold pointed out, despite the recognition of the nursing profession as the backbone of the health care industry, the profession tends to be undervalued and "marginalized to the fringes of influence." She continued by explaining that nowadays, recruiting and retaining nurses seems to be hospitals' primary focus and that the 126,000 nursing vacancies in hospitals (mentioned earlier) was unfortunately understated as the figure continues to grow on a regular basis. Hospitals are waging recruitment battles with sign-on bonuses and salary increases, turning nursing care services into the most expensive commodity in the health care industry sector. The profession is experiencing high turnover and frustration among nurses, physicians, patients, and families, and nurses are abandoning the industry in record numbers for other options. Nursing care has become increasingly difficult to deliver in hospitals, due to a more complex work environment and the fact that understaffing is driving the work intensity for nurses. These problems, coupled with an aging population, have made the work in hospitals increasingly untenable, Arnold explained, with a serious impact on health care access, quality, and cost.

Access to Care Is Reduced

As the nursing shortage worsens, access to care is reduced—hospitals respond to the shortage by reducing the number of beds and by closing services, resulting in hospital crowding, emergency room overcrowding and diversions, long surgical wait times and canceled surgeries, and long outpatient wait times, affecting all sectors of the population.

The Quality of Care Is Compromised

Arnold referred to an article published in the May 2002 issue of the *New England Journal of Medicine*, based on 1997 figures, in which the authors found that with early identification by nurses and by medical and nursing interventions, the incidence of serious complications in hospitals—complications that can severely compromise patient care outcomes—would decrease. For example, upper GI bleeding, urinary tract infections, pressure ulcers, pneumonia, shock, and failure to rescue all were affected by the amount of nursing care services available to patients.

As the nursing workforce shortage worsens, Arnold continued, the quality of care is compromised, as reflected in the clinical indicator defined as "length of stay." For hospitals with high turnover, length of stay can be at least a day longer than those with lower turnover rates, due to reduced productivity and less expert attention given to patient care process. In general, it is recommended that patients get through a hospital stay as efficiently and as quickly as possible to avoid potential complications, Arnold added.

Health Care Costs Rise

Arnold explained that as the nursing shortage worsens, health care costs rise. Recently published data indicated that hospitals with high vacancy rates experienced an increase of almost $1,000 in their costs per discharge. As hospital costs are becoming an increasing source of attention as a contribution to overall health care cost increases, we need to make sure that we manage nursing care costs' contributions to the overall health care costs concern in the nation, she added.

Health Care Research Suffers

As the nursing shortage worsens, health care research also suffers, Arnold pointed out. This is reflected in a decline in access to in-hospital acute care settings, a decline in access to research nurses, and an eventual reduction in medical research that significantly changes the way that health care is delivered.

Arnold concluded by describing the crisis in the nursing profession as a serious downward spiral, starting with increasing vacancies in hospital settings and leading to the need to use premium pay labor—derived from overtime pay and temporary labor—to address issues of decreased morale, higher turnover, serious quality concerns, lower physician and patient satisfaction, and persistent turnover.

Rear Admiral Kathleen Martin (Commander, National Naval Medical Center, Bethesda) spoke about "The Transformation of a Profession: Redefining Nursing and Creating a New Paradigm for Nursing Practice." Martin started by painting the public's image of nursing—corresponding to the image of the profession in the 20th century—and by presenting a picture of where the profession is moving in the 21st century. She asked Forum members to think about the mental model of the nursing profession and how that model needs to be changed. She also invited members to collaborate with the institution to build a healthy nursing profession.

Rear Admiral Kathleen Martin

Nursing in the 20th Century

The generations of which we are a part are the war generation and the Baby Boomer generation, Martin explained. The typical profile of the 20th century nurse was: average gender/race, female/Caucasian; average age, 35; average education, three-year diploma, BSN, AD.

In the 20th century, professional opportunities for women were very limited; nursing was one of the few careers offered to women. Approximately 80 percent of nurses practiced in a hospital/acute care setting. Nurses took pride in what they were "doing for others:" bathing, treating, changing, feeding, intervening, medicating, and discharging. They formed a strong dependent relationship with patients, were very task oriented, and followed physicians' orders. Even then, Martin pointed out, nurses were not considered to be true members of the professional health care team and, unfortunately, received very little respect from other health care professions.

What Will Our Future Nurses Look Like?

Martin outlined the existing generations that need to be taken into account in the 21st century: the Baby Boomers, Generation X, Generation Y, and the Millenniums, posing contrasts in their outlooks on life, work ethic, and the view of authority. The typical profile of the 21st century nurse is average gender/race, female/Caucasian, with an increase in ethnic diversity; average age, 45; average education, AD, BSN, MSN, Ph.D. Nursing is often considered as a second career. The nursing workforce is aging four times faster than any other profession, Martin explained, and not even nurses who are parents are encouraging their children to consider the profession. The hospital no longer remains the foundation for the learning experience (50 percent of nurses now work in a hospital, versus the 80 percent in the 20th century). Martin added that the classroom teacher-driven model no longer predominates in the educational environment of tomorrow. Required skills have shifted drastically from technical to the use of new technology and knowledge of bio- and pharmacotherapeutics that now replace many of the invasive mechanical procedures done in the past. Work characteristics have changed: Work is mobile, decentralized, and extremely fast paced. Today, professional nurses are not necessarily found at the bedside, and health care has moved into an earlier stage of intervention and prevention. Martin underscored the importance for the nursing practice model to move out of the industrial age as nurses can now lead and make time-critical decisions. Nursing now requires competent, independent intervention and the use of evidence-based nursing practice. Despite these changes, nurses continue to struggle with professional identity and respect from other health care professionals.

Martin concluded by highlighting the need to reframe the image of nursing. She referred to a presentation by Vice Admiral Lee Gunn (U.S. Navy, Retired) at the Forum's Winter 2002 Meeting on the Navy's "war on talent" and how it is addressing education, training, recruitment, and retention. She called upon the Forum for collaboration, assistance, and partnership from academe and business to ensure that the nursing profession will stay alive and remain competitive in the 21st century. Martin left members with two questions:

- What lessons can be learned from industry to reshape the workplace and redesign the systems to make the best use of scarce and costly nursing resources?
- How can business and higher education partner with the practice community to transform nursing?

Questions/Comments from Audience

Attendees commended the speakers for overall consistency throughout the different perspectives given on the nursing shortage issue.

Several attendees discussed the possibility of "crash programs," in which medical students can become RNs. They also discussed the creation of a Native American program in nursing—either on or off reservation—possibly financed through the Bureau of Indian Affairs.

Members were told that a discussion should take place on how to design health care delivery systems that use people with a variety of skills in the most effective and efficient ways, to ensure safe, high-quality care.

Several attendees suggested that, with the help of the business sector, it would be possible to redesign the workplace, which would lead to improved delivery of nursing care services.

Attendees strongly felt that with the collaboration of higher education and business, effective solutions could be crafted to train more applicants and to reach out to communities to enhance the diversity of the student population entering the nursing profession.

Moderator O'Connor wrapped up the session by pointing out that the Winter 2002 Meeting session and this Summer 2002 Meeting session on the nursing shortage had provided the necessary questions and data about what this shortage means and how it would play out in the future. He invited members to decide whether they wished to engage in the issue and come up with a set of recommendations. The decision to do so would be made during the Executive Committee meeting later that day.

How Students Are Paying for Their Education

Tim Fitzpatrick

Tim Fitzpatrick (President and COO, Sallie Mae) moderated the session. He opened the discussion by laying the groundwork for the panel, providing an overview of the current cost of postsecondary education and how students pay for it.

Fitzpatrick first pointed out that, annually, the cost of education runs between $120 and 130 billion, reflected through the receipts collected by colleges and universities from tuition, room and board, and other fees for students to attend school. Approximately $40 billion of that total—approximately one-third the cost of education—comes in the form of loans, with parents and students borrowing via Title 4 loans. Another 28 to 30 percent (or approximately $35 billion) comes in the form of grants such as Pell Grants, state and other aid, and scholarships, with the remaining amount (approximately $50 billion) coming from parents' contributions.

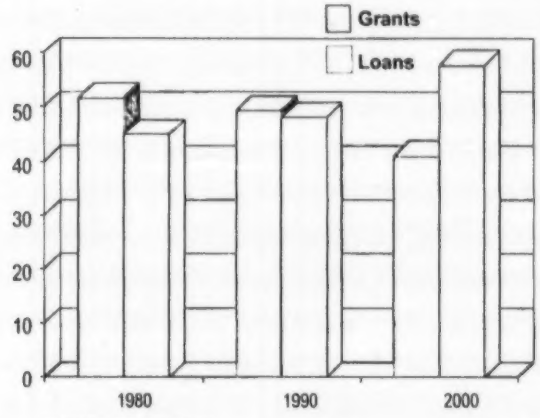
Fitzpatrick continued by giving a snapshot of today's college student:

- One in five, or 20 percent, of college students today are "traditional" students (that is, undergraduates enrolled in a four-year program, living on campus, and between the ages of 18 and 22).
- About 45 percent of today's college students are over 24 years of age, and in every age category of adults 25 to 54, nearly 50 percent or more are enrolled in adult education.
- Distance education—a convenience that comes with a certain price—enrollment has doubled over the last four years.

FIGURE 1

1980 to 2000: Loan-to-Grant Ratio Reversed

Student loans are more important than ever before to help students and families pay for college.



Source: The College Board.

Fitzpatrick then showed how grant aid had kept the pace with the cost of education during the last 20 years. Looking at data published by The College Board, he explained that the loan-to-grant ratio had shifted during the last 20 years:

- In 1980–81, grant aid represented 55 percent of total aid, with loans representing only 41 percent.
- In 2000–01, loan aid increased to 58 percent of total aid, and grant aid decreased to 41 percent *(see Figure 1)*.

He continued by describing how the Pell Grant's purchasing power—designed to help students with the greatest need and the fewest resources to pay for college—had declined over time:

- In 1986, Pell Grants covered 98 percent of average tuition.
- In 1999, Pell Grants covered only 57 percent of average tuition.

Terry Hartle

On average, a student today borrows about $16,000 to complete his or her education, Fitzpatrick noted. He reported that approximately 16 million students currently populate universities across the country and that during the next decade, 80 percent of the 1.6 million additional new students will be come from low-income, minority, and Hispanic populations, leading higher education administrators to question whether the current financial aid structure can properly account for that influx.

Fitzpatrick then turned to **Terry Hartle** (Senior Vice President and Director, Division of Government and Public Affairs, ACE) to talk about why low-income students do not go to college. Hartle focused on three areas:

- What American higher education looks like in 2002.
- The cost of higher education and how it is paid.
- Low-income student participation.

Student Enrollments Continue to Grow

In the past decade, postsecondary enrollments have been surpassing high school enrollments. In 2002, America has 15.1 million high school students versus 15.5 million college students. During a 30-year period, high school enrollments show an increase from 14.6 million in 1970 to a projected 15.4 million for 2010, whereas college enrollments during that same period have increased from 8.6 million to a projected 17.5 million for 2010.

Where Students Are Enrolled

Of the 15.5 million college students in 2002, 9.6 million were enrolled in four-year schools and about 6 million were enrolled in two-year institutions. Most college students attended public institutions (6.3 million attended four-year public institutions and 5.6 million attended two-year public institutions) with a smaller share going to private institutions (roughly 3.6 million).

Students from Upper-income Families More Likely to Attend College Than Lower-income Counterparts

While enrollment in higher education has increased dramatically during the past 30 years, the likelihood that individuals attend college according to income has not changed very much. For example, in 1972 roughly one-third of individuals in the lowest Socio-Economic Status (SES) level went on to higher education from high school; 22 years later, in 1992, the figure climbed to 40 percent. In contrast, the highest SES level shows an increase from 81 percent in 1972 to 87 percent in 1992. This indicates that, after years of federal student aid programs, the number of individuals participating in higher education had been successfully moved up without equalizing the opportunity for participation in postsecondary education at all levels of student populations.

Hartle added to Fitzpatrick's snapshot of today's college student by indicating that:

- Currently, more women attend college than men. In 2000, women made up 57 percent of all students, whereas in 1970 they represented 41 percent.
- There are also more minorities, as Fitzpatrick explained. In 1999, minorities represented 27 percent of the student population, whereas in 1976 (the first year that race was counted), only 15 percent of college students were minorities.
- There are more part-time students—41 percent of today's students are enrolled part-time, compared to 32 percent in 1970.

The Vast Majority of College Students Stay in School and Graduate

About 76 percent of individuals starting college in the fall 2002 will either be graduates or will still be enrolled in five years, Hartle reported. He further indicated that persistence rates among low-income students going to college are similar to rates for upper-income students.

The Average Price of College

Figures are not as high as people believe, Hartle indicated:

- 41 percent of all college students attend four-year public institutions with tuition and fees (strictly the price of education) amounting to $3,800 and the cost of attendance (tuition and fees compacted with books, supplies, room and board, transportation, and other expenses) at $11,976.
- 21 percent of all college students attend four-year private institutions, with tuition and fees at $17,123 and the cost of attendance at $26,000.
- 36 percent are enrolled in community colleges, where tuition and fees are approximately $1,700.

Roughly 70 percent of all college students in four-year institutions face tuition and fee charges that amount to less than $8,000 per year, Hartle indicated. By comparison, the average tuition of a private secondary school in 2001–02 amounted to $14,164, while the estimated average annual child care costs (based on U.S. Census data) amounted to $9,600.

Sources of Financial Aid

Hartle explained that about 70 percent of all financial aid comes from the federal government, and the vast majority of federal student aid is in the form of low-interest, subsidized, guaranteed loans, adding that Sallie Mae plays a central role in helping students repay these loans. Generally speaking, low-income students are automatically expected to take loans to finance their education and, as mentioned earlier, low-income students are much less likely to move into higher education than their upper-income counterparts; this is true even for well-educated and well-prepared low-income students.

Why Don't Lower-income Students Attend College?

Three hypotheses were given: lack of academic preparation, lack of knowledge/information, and lack of money. All three undoubtedly play a role, Hartle explained.

1. Lack of Academic Preparation

A large number of low-income high school graduates do not meet the minimal standards necessary to succeed in college. Minimal standards include a 2.7 grade point average, an 820 SAT score, and a 54th percentile class rank. About three-quarters of the lowest SES high school graduates do not meet these criteria, Hartle pointed out.

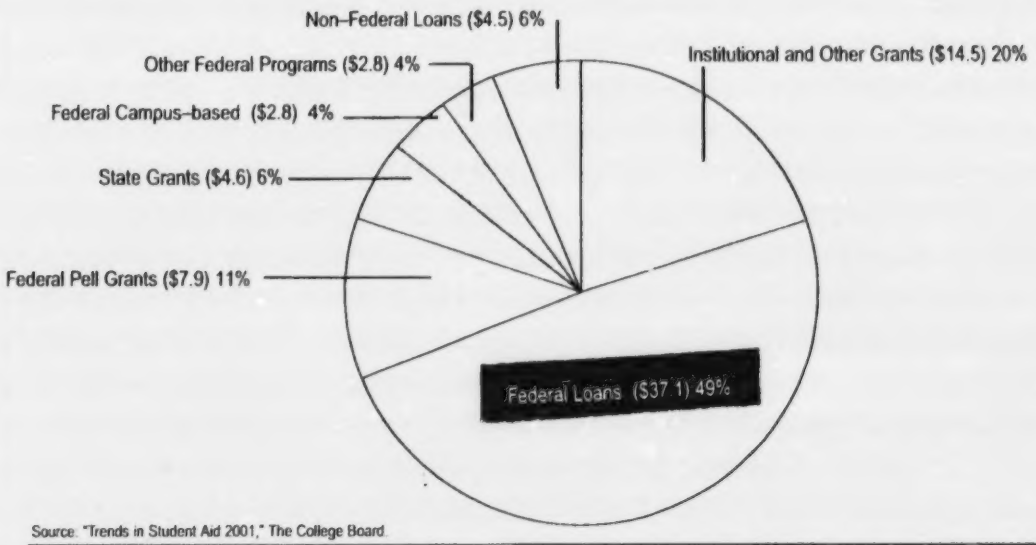
2. Lack of Knowledge/Information

Surveys are regularly conducted to find out how much the public thinks it costs to enroll in higher education. Typically, when asked how much they thought it cost to go to a two-year school, a four-year public school or a four-year private school, individuals between the ages of 21 and 60 tended to badly overestimate the cost of higher education. For example, in an ACE survey conducted in 1998, the total cost of attendance at a two-year public community college was about $6,000. However, when asked what they thought, the public estimated a total cost of $9,900. In November 2001, ACE repeated the survey and asked the public to estimate tuition fees only (the cost of education only, excluding room and board and other expenses). They estimated that tuition fees would amount to $11,637, whereas the actual average price was $3,754 *(see Figure 2)*.

3. Lack of Money

Despite the amounts of financial aid available, Hartle explained, even after including grants and loans, low-income students have a large amount of unmet need (the amount of money between

FIGURE 2
Sources of Financial Aid for Academic Year 2001–2002 (in Billions)
Total Aid Awarded: $74.4


Non-Federal Loans ($4.5) 6%
Other Federal Programs ($2.8) 4%
Federal Campus-based ($2.8) 4%
State Grants ($4.6) 6%
Federal Pell Grants ($7.9) 11%
Institutional and Other Grants ($14.5) 20%
Federal Loans ($37.1) 49%

Source: "Trends in Student Aid 2001," The College Board

the average cost of attendance and the average amount of student aid that people get). Typically, a student from a low-income family—with a household income of less than $25,000—wanting to attend a four-year public school will be about $4,000 short, even after receiving all eligible financial aid. Students will make up this shortfall by working: 80 percent of college students work an average of 20 hours per week, the equivalent of part-time work with full-time attendance at school.

Peter Smith

Hartle concluded by underscoring the unmet promise of student aid: Despite the billions of dollars made available by the federal government, despite the clear and unambiguous importance of higher education for personal economic success, the way to get low-income students into higher education at the same rate as upper-income students still has not been figured out.

Peter Smith (President, California State University Monterey Bay) challenged the Forum by thinking outside the box on the issue. He commended the Forum on its recently published diversity report, *Investing in People: Developing All of America's Talent on Campus and in the Workplace*, and on the framework established for a timely and valuable report in view of the Higher Education Reauthorization bill. He encouraged the Forum to boldly pursue its policy recommendations through such reports.

Smith focused on the financing issue. He made the following assumptions:

• Institutions generally need to "gatekeep" existing financial aid, and very little institutional aid exists at the federal level. These facts, together with contributions at the state level, suggest that most increases in the budgets of existing government education programs, while important, will have little impact on serving the new populations that will propel our country to succeed or enhance the value proposition of education as described in the Forum's report, *Investing in People*.

- It is unclear whether the country is ready or able to foot the capital and personnel costs required by a dramatic expansion of the current system to meet the anticipated need, let alone to maintain the commitments that are already on the table—for example, capital infrastructure—in the approximately 3,700 public/private and other institutions. Although work must be done to increase funding at all levels, it is uncertain that the large societal and workforce game will be won.

Smith continued by giving his view of the current environment and a working definition of the problem that needs to be solved. He used the three driving forces—as outlined in *Investing in People*—that are radically changing today's higher education environment:

- Demographics.
- A change in the knowledge base regarding how people learn.
- The continuing changes in technology and the access to the World Wide Web and their impact on the teaching-learning process.

These three forces need to be considered collectively, Smith said, while trying to understand their synergy and its impact on the problems that need to be solved.

Demographics

- The changing population requires that we become much more successful in educating millions of young people with whom we have not, historically, been successful to high levels of standards, Smith added. He expressed concern that at the K–12 and postsecondary level, the system had failed to understand how to touch the intellects, the capacity, and the hearts of these millions of young people.

When adult degree and continuing workforce development needs are added to this picture, a very different "shape" of service target population is obtained: Compared to a small triangle in the 1940s, today's cohort of 18-year-olds would look more like a quadrilateral with a much larger base at age 18 and expanding as the age increases. With this newly described population, Smith summarized, the requirement is to succeed to high standards with historically high-risk and underserved populations.

A Changing Knowledge Base

Smith explained that in the years ahead, it will be as unthinkable to enroll a student in a college, university, or any other kind of educational program without a full learning inventory and profile of that student, as it would be today to admit a patient to the hospital without a routine workup. By the production of new knowledge and science of how people learn, excuses for failing these students are being reduced.

Changing Technology

Changing technology radically alters the economics of place, time, and people in teaching and learning while transforming the potential for deeper learning for many more people, Smith said, adding that the tools for success were being strengthened.

Smith echoed the objective that the Forum outlined in *Investing in People:* to educate a future workforce that will not only keep America competitive in the global economy but also will significantly increase the number of citizens entering or participating in adult life who are socially, civilly, and economically literate.

He then identified two population cohorts: individuals with untapped potential and individuals with untapped knowledge. Young people with untapped potential are those who have the capacity to learn, but who have not succeeded in school.

Untapped Potential

According to recent data:

- 61.6 percent of the Hispanic population, 88.7 percent of the black community, and 93 percent of white citizens are achieving high school degrees.
- 62 percent of the white students, 59.25 percent of black students, and 42.2 percent of Hispanic students who graduate from high school go on to enroll in college.

We also know that:

- College graduation rates, across the board, are in the neighborhood of 70 percent after six years.
- Persistence to graduation rates from 12th grade through the baccalaureate heavily favor higher income learners from educated families.
- Areas of projected population growth correspond to those areas where we have failed to succeed historically.

Smith explained that with the current performance level, if we begin with 300 12th graders—100 from each ethnic group—by the time we reach the end of the sixth year of baccalaureate work, about 100 of them will have a degree. He cautioned that if educators take no action, the success rate would decline as the demographics change. He also said that millions of learners would have slipped through the cracks in the K–12 system without having been detected in the drop out numbers. In *Investing in People,* he said, the Forum had put a $200 billion plus annual tag on the value of the loss.

Untapped Knowledge

Adults with untapped knowledge are those who have knowledge and experience beyond the credentials they carry, Smith explained, adding that data were not available in this area. "There is an enormous lost opportunity cost contained in our inability to harness the knowledge and experience that they have, let alone add to that knowledge through organized workplace-based or institutional or web-based learning programs."

This situation results in extraordinary pressure on the traditional academic model, he pointed out. It is crucial, Smith further explained, that new technology and new knowledge about the way people learn be brought into the educational process.

Smith suggested adding other types of recommendations to the ones that increase the value proposition of education as a matter of federal and national policy:

- Accountability and quality assurance. As outlined in the upcoming report on Learning and Technology, based on information and research; institutional outcomes assessment through a reformed accreditation process; value-added assessments such as the National Survey on Student Expectation and the Baldrige award; the basis for a second level of accreditation (approved and superior).
- Assessment. Establish a national, nonprofit clearinghouse for the validation and assessment of uncredited knowledge and experience with outcomes standards that reflect a broad set of needs, including the needs of business and industry.
- Access and retention. Develop a learning profile diagnostic for all students and require its use if federal money is to be received.
- Using tax and accreditation policy. Create an environment supportive of innovation in the development of new services and new types of organizational structures to serve the emerging need.

Smith concluded by emphasizing the need for new revenue sources, new partnerships, a redefinition of value, and new types of comprehensive services and organizations in order to meet the benchmarks laid out by the Forum in *Investing in People.*

Comments from Audience

Members were informed about a recently completed national survey by the Thomas Rivera Policy Institute of 1,000 Latino parents on their college knowledge—regarding financial aid as well as general knowledge of the different types of colleges and the programs/tests that they offer. The survey results showed low levels of knowledge, affected mainly by SES, immigration status, and language barriers hampering access to the information. The report will be made available for Forum members.

Members also were told about discussions between Sallie Mae and ACE on a possible collaboration to encourage Congress to underwrite a national advertising campaign on access to higher education, particularly aimed at low-income and minority communities.

Richard Brown (BHEF Sister Forum, United Kingdom) presented the UK perspective on "Why Students Do Not Go to College." He pointed out that in the United Kingdom, the principal reason was lack of entry qualifications and lack of knowledge/information on financial support. He echoed the problem of low-income students carrying the burden of loans and needing to work longer hours in order to pay back their debts. He explained that the shift from grants to loans did not substantially affect participation levels, but that aspiration was the key. One task of the UK Forum is determining how to draw the attention of individuals to the benefits of investing in learning, Brown told members. "The more you learn, the more you earn," he said. He concluded by underscoring the belief that government support should go to institutions to help retain the most needy students in higher education.

Members heard from John Biggs of TIAA-CREF about its "529 Plan," a new type of saving plan for young people, encouraging them to prepare financially for college. Although most other strategies are based on ways to pay for college with loans or parents' income, the state 529 Plans are already reported to have accrued $3.5 billion. For example, Georgia started its 529 Plan in spring 2002, and New York, the first state to join the plan, started two years ago. At the end of 2002, the plan is projected to have accrued about 30 percent of the funds—or $10 billion—and it is expected that in five years, funds will have reached $50 billion (all of the funds are invested and must be used to pay tuition, room, and board). The plan is said to be successful in reaching blue collar as well as higher income employees. The company announced that it would be launching a consortium of about 300 private institutions offering a tuition guarantee plan, administered by TIAA-CREF. However, 529 Plans are not accessible to lower income families, most of which currently do not participate in postsecondary education.

Costs of tests such as the SAT and ACT, as well as application formalities, also were identified as barriers to needy students trying to enter higher education.

Members described the current financing situation as an "invisible" and "inaccessible" system of loans, grants, and tax credits for the "select few," versus a transparent, functional system allowing the whole population to access the system, the model recommended for economic success.

As the third largest public beneficiary program run by the government, the federal student loan program can be complicated. More than 11 million people per year apply for federal student aid; the question is how to reach out to people early enough to show them the possibility that they can go to college and that significant financial aid is available.

University Outcomes and the Workplace

Dennis Smith (Forum Chair), moderated the session. He introduced the topic by referring to the passage of the "No Child Left Behind" Act and annual testing for K–12 that will begin in 2005 and by reminding members that the *Higher Education Reauthorization Act* was due for reauthorization in 2003, thus creating increasing pressure to develop some protocol for making colleges and universities accountable. The higher education community now faces the question of whether students and faculty should be tested at the college and university level. Smith explained that since grades 13 to 16 can be viewed as the continuation of high school and since testing will be required at the high school level, it could therefore also be required at sophomore, junior, and senior years of college. If testing is implemented, the question will be: What will be tested?

Hank McKinnell

Smith referred to the Forum's report, *Spanning the Chasm: A Blueprint for Action,* and to comments made by business leaders indicating that what they wanted most from graduates they employed were: communication skills, the ability to work in teams—including leadership skills—problem-solving skills, analytical thinking, flexibility, the ability to work in a diverse context, understanding globalization, and a need for adequate ethics training. Graduates' quotations from *Spanning the Chasm* indicated areas in which students had not effectively developed some of the above-mentioned skills.

Peter Magrath

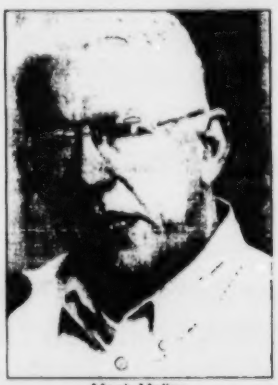
Hank McKinnell (Chairman of the Board and CEO, Pfizer Inc) opened by giving a business perspective on the importance of standard setting in the measurement of outcomes. Assessment is needed, he underscored; the problem is, where do the standards come from, and how can we anticipate results that will be seen a number of years down the road?

McKinnell drew parallels between education and medicine, pointing out that medicine also was concerned about outcomes. Medical researchers have conducted epidemiological studies over the years showing the impact on health risk of different behaviors, he explained. In education as well as in medicine, it is important to define the drivers of a successful outcome. McKinnell expressed interest in conducting a survey of graduates from different institutions, highlighting samples of individuals who succeeded in life and those who did not succeed, and to analyze what these individuals did with their lives and whether it was related to their four years in college.

McKinnell concluded by proposing a different approach to the process of measuring students' performance. He suggested introducing the content of final exams at the beginning of the school year to show students what the university expects of them in order to succeed at the end of the year.

Peter Magrath (President, National Association of State Universities and Land-Grant Colleges [NASULGC]) underscored the importance of the need for "thinkers." He explained that the mission of NASULGC, while embracing liberal arts, learning, and thinking, was to prepare people for life, in society,

and for the workplace. He reminded the audience that since the earliest days of higher education in the United States—at that time, overwhelmingly private and male—colleges had a vocational mission to prepare men for pursuits in law, in the military, and in the ministry. He echoed the comments in *Spanning the Chasm,* Volumes I and II *(Corporate and Academic Cooperation to Improve Work-Force Preparation,* January 1997, and *A Blueprint for Action,* September 1999) on the mission of higher education in preparing students for work and for life. He pointed out that surveys overwhelmingly showed that the public believed that providing education in basic skills, career training, and retraining, and preparing people to function in a diverse workplace are the major goals of higher education. The public also believed, he added, that higher education is essential to a well-trained workforce and that students should "get out of college" qualities such as a sense of maturity and how to manage on their own, an ability to get along with people different from themselves, and an ability to solve problems and to think analytically.



Monk Malloy

To answer the question of whether outcomes can be measured, Magrath referred to a recent report by the National Center for Public Policy and Higher Education, *Measuring Up 2000,* that measured five indicators of state higher education performance: preparation, participation, affordability, completion, and benefits. According to the report, due to lack of information on the educational performance of college students that would permit a systematic state or national comparison, "learning" was not measured. Magrath pointed out that measuring "generic learning" would not be possible through standardized assessment tools. He quoted Governor James B. Hunt Jr.'s comments on the importance of tracking and monitoring higher education and its performance; however, Hunt emphasized that counting learning outcomes in a statistical analysis is unlikely to succeed. Magrath concluded by outlining three recommendations he would favor:

- Ask businesses and employers to give their views on higher education's performance.
- Establish business advisory councils for colleges, including real dialogue with faculty and academic administrators at colleges.
- Engage in a robust debate on these issues with "counters who think and thinkers who count."

Monk Malloy (President, University of Notre Dame) spoke about the significance of quantitative measurements in the admission process of the institution. He explained that criteria used to assess applicants included high school career achievement as well as other "intangible" skills such as leadership, generosity, commitment to the common cause, and the ability to articulate a dream and vision for the future. Overall, class rank was the most important.

Malloy mentioned the difficulties experienced in measuring aspects such as personal integrity and standards for ethical behavior due to uncertainty as to whether these aspects are a function of a lifetime of performance, of passing tests in crucial situations, or of the capacity to change over time. He underscored the importance of preserving the interview stage of the hiring process in business and in higher education. "The hardest things to gauge," he said, "are those intangible matters of the heart and spirit; they are the necessary part of a healthy life and of a consistent participation in any workforce or any group." He concluded by recognizing the need for testing and reiterated the importance of taking the intangibles into account when evaluating the job that higher education is doing.

Ed Rust (Chairman and CEO, State Farm Insurance Companies) concluded the panel presentations by speaking of his own experience and how he became involved in education reform issues. After the company had debated whether or not to use basic aptitude tests in the hiring process, he had to respond to letters from parents asking why their son or daughter had not been hired. Rust echoed his Forum colleagues' comments on the importance of a broader assessment of applicants' learning and experiences. He strongly recommended that—considering the collective and collaborative efforts of its experiences, its membership, and shared perspectives—the Forum address this issue.

Ed Rust

Rust recommended that the Forum anticipate the key public policy issues, engage in the debate, help shape the issues addressed, and respond accordingly. He underscored that with the efforts in the K–12 arena, the *No Child Left Behind Act,* the growing awareness among parents regarding expectations in terms of standards and performance, and the growing costs of going to school, the accountability issue had become very present in parents' minds. Rust emphasized that accountability would continue to be present in higher education when parents ask what they are getting in return for the tuition and financial support given for their children to complete higher education. Students also will ask, when they graduate, whether it was a good experience and whether it enhanced their performance, understanding, and core skills that they need, not only to be good citizens but also to enjoy lifelong learning experiences.

Rust reiterated the need for business and higher education to work together in light of interest in this area by public officials—business can provide a good perspective of some of the "changing skill expectations" seen in the workplace. He emphasized that higher education should not be regarded as a job-training program and that the "intellectual, life-changing experiences" that are acquired during higher education have no direct tie to job training and are an "essential element of success outside of the university setting." He concluded by underscoring the importance of outcomes from both the university and the business settings that will help drive desired results.

A constructive dialogue with Forum members in the audience followed, during which views were shared on possible ways of pursuing the outcomes measurement issue in higher education.

Chairman Smith closed the session by inviting members to think about whether they would want to take a position on the issue to influence discussions in view of the *Higher Education Reauthorization Act.* The topic was scheduled for consideration at the Executive Committee meeting.

Regional Economic Development

The session was held at North Carolina State University's Centennial Campus. Ed Shonsey (President and CEO, Syngenta Seeds, Inc.) and Mark Wrighton (Chancellor, Washington University in St. Louis) moderated the session. Molly Broad (President, University of North Carolina) first introduced **Marye Anne Fox** (Chancellor, Centennial Campus, NCSU), who welcomed Forum members to the campus. Fox gave a brief overview of the important role that three universities played in the development of the Research Triangle: North Carolina State University, the University of North Carolina at Chapel Hill, and Duke University. She explained that the Centennial Campus, dedicated to research and technology transfer, had been so designated pursuant to a land grant given in the university's centennial year. Four areas had been identified as targets for partnership development on the campus: Information technology and networking, advanced materials (including polymers, magnetic materials, semiconductors, and so forth), biotechnology and genomic science, and environmental sustainability. A major focus on K–12 education also was said to be expressed through a magnet middle school focusing on science and mathematics, specially intended for underrepresented groups. Fox explained that approximately 60 companies currently worked on the campus, all of which had a strong programmatic relationship with the university, either through collaborations as adjunct faculty members of their employees or through sponsored research programs, fellowships, or endowed positions. Faculty must work significantly with each one of the partners, she added. The campus was composed of about 1,500 students, supported through jobs, internships, or co-op opportunities, and about 1,500 employees, many of whom acted as adjunct professors working with the College of Engineering.

Marye Anne Fox

Ed Shonsey

Fox told members about the rapid growth in the biotechnology/genomics science section, in collaboration with Research Triangle Park (RTP) partners such as Biogen, GlaxoSmithKline, and other smaller companies. Ranked fourth in the nation's top start-up companies, about 74,000 jobs had been created based on intellectual property generated at North Carolina State University in collaboration with its partners, representing the equivalent of more than $2 billion pumped into North Carolina's economy.

Ed Shonsey gave an overview of how the Regional Economic Development topic had originated. He explained that pursuant to an Executive Committee decision at the Summer 2001 Meeting to follow up on the Research Collaboration Initiative work—which resulted in the report *Working Together, Creating Knowledge* in June 2001—"ad hoc" sessions on Regional Economic Development are the best and most holistic way to pursue the topic. The purpose of the sessions would be to:

1. Hear about the different, unique approaches that have been successful, alternating with shared experiences about less successful approaches.
2. Find possible common themes that can be reapplied throughout all U.S. states, universities, and businesses.

Mark Wrighton

Mark Wrighton provided his perspective on the importance of the topic with a more in-depth look at the programs at Washington University in St. Louis. Wrighton echoed Chancellor Fox's opening remarks on the impact that research universities have had on their local communities. Speaking of the Research Triangle experience, he added that with the funds invested in research support, employment also was associated with bringing research dollars to the region. He described the region as "extraordinarily successful," with three great research universities, a hefty investment from the federal government in major research laboratories, and an environment among civic and elected officials encouraging entrepreneurship and bringing the benefits of science and technology rapidly to the region's population. Before turning to the speakers on the panel, Wrighton told the audience that he would report on the results presented by the panelists to his colleagues in St. Louis.

Ioanna Morfessis (President and CEO, the Greater Baltimore Alliance) shared an example that the Alliance considers to be a new model for approaching urban economic development in the 21st century. She opened by contrasting Baltimore to the Research Triangle region and the Raleigh-Durham area, indicating that they were two very different markets but with many commonalities. She described Baltimore as an older urban market with a diverse economy that has undergone a lot of rebuilding, refining, and redirecting. She described the issues that the Forum had been, and still was, addressing as germane, not only to the competitiveness of the United States but to the issue of national security as well, noting that the Alliance was working on these issues with the educational and business leaders associated with the organization.

Ioanna Morfessis

Morfessis explained that the model used in Greater Baltimore had been generated from the need for a "leapfrog" strategy. Due to the city's diverse and resilient economy, it was not possible to rely on "clusters" as a sufficient model to build economic success for the future (the "Clusters for Innovation" were later presented by Molly Broad, President, University of North Carolina). With change occurring rapidly, a different approach was needed to ensure that the urban U.S. economy is sustainable into the future, Morfessis explained.

She outlined the new realities that are being dealt with in the 21st century—such as homeland security and the erosion of trust in big business, both of which have resulted in a vastly expanded presence of government in the economy, business, and private life—and that are affecting a lot of business and institution decision-making. She continued by explaining that despite all these changes, the long-term survival and success of companies still remained centered on their ability to "keep and attract the best talent."

Morfessis expanded on the concept of the "talent tabernacle"—where the ability to build, create, and foster the growth of intellectual capital in the nation and in companies and organizations is enshrined—as the essence of the ability to be successful in the future. She referred to Admiral Kathleen Martin's description of the values of previous generations as she highlighted the changes in the dynamics of the current market, with the employer being in the driver's seat in terms of winning the "war on talent." Currently, more talented individuals can be found in the market, and employers have the possibility to go after the best talent. Morfessis explained that the Greater Baltimore Alliance had decided to base its entire economic and community development strategy on the younger generations—the Millennium, Gen X, and Gen Y—due to emerging signs of a diminishing supply of talent (15 percent between 2000 and

2015) in the older age groups (i.e., 35- to 44-year-olds) and to an aging population. Some communities will therefore win young people while others will not. The latter will be the "economic abysses" of the future, she stated, pointing out that Baltimore did not want to be one of these abysses. She linked the success of Research Triangle communities to the in-migration of young people, and underscored that the biggest challenge for communities across the country would be to sustain such successes over the long term.

What drives decisions among young people in terms of where they decide to live and the companies they want to work for was the basis of research carried out by the Alliance. Findings showed that lifestyle choices were based on the values that are "idiosyncratic to age cohorts," that is, the values of each generation drive the choices they make in terms of where they want to live, go to school, and work, as well as the products they want to buy. Results from various focus groups conducted around the country among young people showed that, among the qualities most important to young people, diversity was the most important dominating value for 15- to 24-year-olds (Gen Y) and for 25- to 34-year-olds (Gen X). Morfessis explained that young people in America today had grown up in a post-civil rights, post-affirmative action era and that they tended to be gender blind, color blind, and socioeconomically blind. Overall, young people expressed the desire to live in communities that welcome newcomers and value diversity, offering opportunity for interaction among a more global population (computer technology and the Internet have already shaped the young adolescents of today to communicate with the rest of the world). Survey results also showed that young people did not expect to have the earning power of their parents. The Greater Baltimore Region was presented as the "one region where community, business, and education enable the individual to thrive."

Tim Tyson

Morfessis gave examples of new alliances having formed, such as "Colltown" (the Baltimore Collegetown Network, an alliance of 38 colleges and universities in the Baltimore metropolitan area) and the Greater Baltimore Cultural Alliance. She added that the Coalition for a Greater Baltimore joined with philanthropy, human service providers, business and industry, and government at multiple levels to ensure that the agendas align with where they need to be as a community, in order for young people to stay and thrive in the Baltimore area.

Tim Tyson (Vice President, Global Manufacturing and Supplies, GlaxoSmithKline) spoke about social responsibility and corporate stewardship. "Understanding what it means to be a good corporate citizen in the context of shaping economic development and supporting education in Research Triangle Park and North Carolina is fundamental to GlaxoSmithKline," Tyson told members. He referred to the Greater Baltimore Alliance's accomplishments as a role model for what partnerships can create in a community. He underscored the crucial role played by business in developing partnerships with academia and government. Considering Research Triangle Park (RTP), the concept of public-private partnership between the University of North Carolina, Duke University, North Carolina Central University, and North Carolina State University was introduced in 1960 with four companies and 500 people. Currently, there are about 150 companies, with a total of more than 44,000 employees. Tyson explained that RTP was a hotbed of ongoing growth in pharmaceutical, biotechnology, telecommunications business, and research and development (R&D). He pointed out that growth led to economic challenges with growing traffic problems, stress on schools, and pressures that increased the cost of living. Collaboration between business, academia, and local government were key to solving these issues, he continued.

Tyson elaborated from the employer perspective in the field of pharmaceuticals, emphasizing that it was important for the industry to attract and retain a highly educated and competitive workforce of motivated individuals. The pharmaceutical industry needs chemists, scientists, engineers, manufacturing professionals, information technologists, sales and marketing people, and other specialists, he said. Other than salary and benefits, Tyson explained, the quality of life of employees—both on and off the job—was an important factor in the competitiveness of the company. Partnerships with other organizations are key to improving life in the region's communities, he added, underscoring the importance of true commitments, involvement, and relationships with academia, with the local government community, and with the business sector.

Molly Broad

The values that make a company a good corporate citizen "must be the values that guide the actions and decisions of every member of the company, and the foundation must be integrity" Tyson stated. Issues affecting employees, such as transportation, schools, culture, and housing opportunities, also are issues that affect the region and need to be analyzed. He spoke of a "symbiotic activity" that requires focusing on the future in order to thrive in challenging times.

GlaxoSmithKline is involved in different collaborations in the area:

- The Regional Transportation Alliance, which comprises business executives, representatives of various Chambers of Commerce, university administrators, and state and local legislators.
- Collaborative research partnerships between GlaxoSmithKline and neighboring universities—for example, a partnership with the North Carolina Bio-Informatics Research Center.
- The Biomedical Research Institute.
- "The Future of Our Kids," a program designed by a group of MBA students to motivate high school students to explore the educational opportunities to make conscious decisions about their future.

Tyson concluded by emphasizing that in order to see initiatives such as the Research Triangle Park flourish throughout the United States, it is crucial that we sustain partnerships between community, academia, and business.

Molly Broad (President, University of North Carolina) described an important strategy for regional economic development, based on Michael Porter's (Harvard School of Business) concept of "Clusters of Innovation," (published by the Council on Competitiveness, October 2001*).

Broad gave an overview of a complicated set of analytical tools, asking members to try to get a sense of the approach rather than to focus on all the details. She started by explaining that Michael Porter—with the Council on Competitiveness—had set out to test the notion that Clusters of Innovation (that is, industries mutually supportive of one another and geographically proximate and that contribute to economic productivity) is the basis of significant economic development. The strategy begins with defining the company's strengths and competitive advantages as well as its disadvantages and challenges, Broad explained.

Clusters of Innovation is outlined in the following points:

- The general approach to Clusters of Innovation is rooted in the belief that standard of living is determined largely by the productivity of the economy. Increased economic growth and development is dependent on an increase in productivity. High productivity requires innovation.
- Productivity does not depend on types of industries in a region. There are currently no low-tech industries, but only low-tech firms (companies in an industry that do not take advantage of the benefits of technology).

*Michael Porter's report, *Regional Clusters of Innovation*, can be viewed at www.compete.org.

- Innovation can drive productivity improvements in virtually every industry. It is much more than scientific discovery; it is how knowledge is transformed into a commercial product.

Definition

Clusters are defined as geographically proximate groups of interconnected companies and associated institutions in a particular field, linked by customer, supplier, or other relationships.

Thesis for Clusters of Innovation

Researchers observed significant geographic concentrations by setting aside businesses existing in every local region (grocery stores, drugstores, dry cleaners, movie theaters, etc.), by aggregating the rest of the industries into approximately 50 industries, and by plotting employment and patents in these industries by county.

What Is a Cluster?

Broad used the wine industry in California as a good example of a Cluster involving a variety of players in close proximity—products/service companies, suppliers of input goods/services, firms in related industries, with an extension into tourism, education support, and participation from state government agencies.

In its study, the Council on Competitiveness selected five areas: Research Triangle Park, San Diego, Wichita, Atlanta, and Pittsburgh. The study examined each of these regions according to various indicators of economic vitality and standard of living (such as employment, wages, cost of living, and exports). By measuring innovative output, entrepreneurship, patents, and venture capital, the study endeavored to assess potential future competitiveness, Broad explained.

Research Triangle Park

The primary Clusters studied in RTP were:

- Biotechnology/pharmaceutical and communications equipment—the two major Clusters.
- Smaller Clusters in chemicals, as well as fiber and plastic.

A number of advantages and disadvantages were identified.

- Advantages included: a large number of scientists, engineers, and skilled technicians; nationally recognized universities; high levels of R&D; and a central geographic location.
- Disadvantages included: inadequate supply of risk capital and venture capital expertise; few company headquarters; and weakness in specialized suppliers.

Especially high-ranking Clusters for RTP were Communications (ranking sixth in the nation); Information Technology (ninth); and Education and Knowledge Creation (14th). Employment rates by industry were analyzed, showing a significant loss in manufacturing jobs in the Apparel and Textile area.

Broad presented analyses of two major Clusters in RTP:

- The Biotechnology/Pharmaceutical Cluster. RTP ranked sixth in the nation in terms of total employment. The analysis showed that while RTP benefited from nation-leading research-based activities and from a competitive workforce, weaknesses in specialized venture capital and in specialized services were significant. Assets and challenges also were evaluated in the Biotechnology/Pharmaceutical Cluster, showing a strong innovation environment, good R&D, high-quality universities, and strong linkages with industry; however, inadequate incentives for investment, lack of local government cooperation, and growing traffic congestion all represented challenges for the region.
- The Communications Cluster. RTP ranked seventh in the nation in total employment. The Cluster grew in response to increasing demand for communications equipment technology, with university R&D playing a major role. Sophisticated multinational firms (such as IBM and Nortel) operated in the region, and large numbers of employees were reported. However, a modest average growth rate was noticed in the last few years, and reasonable wages (but not among the highest in the nation) and patent development.

The analysis also showed a strong innovation environment based primarily on R&D, a highly trained labor force, and challenges such as modest cooperation among firms to engage in jointly developed technology and the need for a streamlined regulatory environment.

Results from a series of interviews of individuals in leadership positions showed positive and negative attributes:

- Positive attributes included tight-knit leadership, high quality of life, and exceptional universities.
- Negative attributes included infrastructure problems, i.e., poor condition of roads and airports, lack of quality K–12 education, lack of coordinated leadership across government with a shared vision.

Broad listed the lessons learned and opportunities identified by the Porter analysis.

Lessons Learned

In addition to the strengths identified in the analysis and interview outlined above, RTP also benefits from a strong pool of scientists and engineers, specialized talent in training, strong R&D, and institutions that are highly engaged in collaboration, innovation, and strong leadership.

Opportunities

Opportunities for developing a broader, more integrated economy were identified, as well as recommendations to reach geographical areas beyond RTP and opportunities to support the development of major corporate headquarters in the RTP region.

Broad pointed to the intersection of the three major RTP Clusters—Biotechnology/Pharmaceuticals, Communications, and Education and Knowledge Creation—as offering enormous potential opportunities for the future. Recommendations to move into areas such as analytical instruments, medical devices, chemicals, environmental sciences, and bio-informatics would enable universities and business to build on existing strengths to expand the region's economy.

It is important, Broad concluded, that all segments of the community move in the same direction with government improving the business environment, the private sector embracing the central role of innovation, universities facilitating the exchange as well as the creation of intellectual property, and institutions of collaboration (not-for-profit organizations) helping to bring the intellectual property through technology transfer in preparation for moving into the private sector and attracting venture capital.

A discussion with audience members followed, during which attendees asked how models such as the Greater Baltimore Alliance and the Clusters of Innovation Analysis could be expanded to other regions and communities in the country.

Moderators Shonsey and Wrighton wrapped up the session by asking two questions that Forum members should pursue: Does RTP represent the best model of corporate investment and, in light of the recent financial crises in the corporate sector, what can Forum university members do to encourage more confidence in the business community?

Executive Committee Report

Ed Rust (Incoming Forum Chair) reported on the key issues raised by the Executive Committee regarding ongoing initiatives as well as new projects.

☐ Learning and Technology Initiative

Committee members agreed to move to Phase II of the Learning Transformation and the Role of Information Technology Initiative. The committee expects to complete this initiative by the end of 2002. The Forum also is seeking further funding for Phase II of the Initiative.

☐ Math and Science Education Working Group

The committee agreed to pursue this project as an initiative. Dennis Smith (Immediate Past Chairman) and Bob Jones (President and CEO, National Alliance of Business) chair the group.

☐ University Outcomes and the Workplace

The committee agreed to launch a working group that will define issues and perspectives on the issue of assessment of higher education outcomes, to prepare for a plenary session at the Winter 2003 Meeting. Charlie Reed (Chancellor, The California State University), Ed Rust, and Dennis Smith will lead this effort.

☐ The Crisis in the Nursing Profession

Rust thanked Dennis O'Connor for his leadership in building the Forum's understanding of the many issues involving the shortage of nurses. He encouraged Forum members to interact as individual institutions on the issue.

While the committee recognized the issue of faculty shortages in business schools, members felt that due to current resources and time constraints, the Forum could not give the matter immediate attention. The issue might be addressed at a later date.

☐ Regional Economic Development

The committee agreed to pursue the discussion, with the focus on collaboration among universities and business in Georgia, at the Winter 2003 Meeting in San Diego.

Outcomes

- Ed Rust reported on the status of the membership (currently 75). He pointed out that the Forum needs more corporate members (currently there are 29) and that work in this direction was underway.
- Hank McKinnell agreed to chair the Membership Committee, succeeding John Biggs.
- Mark Wrighton (Chancellor, Washington University in St. Louis) was voted to the position of Vice-Chair of the Forum; he will assume the Chairmanship in 2004.
- It was confirmed that the Winter 2003 Meeting—to be co-hosted by Augie Gallego (Chancellor, San Diego Community College District)—would take place at Torrey Pines in San Diego, January 30 to February 1.
- It was agreed that the Summer 2003 Meeting would take place in Washington, DC. Jack DeGioia (President, Georgetown University) agreed to co-host the event. The committee saw this as an important venue in regard to the Congressional legislative agenda on education issues.

Learning and Technology Initiative—Next Steps

Molly Broad (President, University of North Carolina) and Sean Rush (General Manager, Global Education Industry, IBM), Co-chairs of the Learning and Technology working group, reported on the progress of the Initiative.

Molly Broad gave an overview of the Initiative and its timetable. She explained that the Learning Transformation Task Force had originated from the realization that in order for the nation's economy to continue to be competitive globally, the level and quality of education of its citizens—K–12, higher education, lifelong learning—needed to be enhanced. Concerns about enough resources being available through traditional means such as reducing class size, expanding the numbers of school buildings, and increasing teachers' salaries coincide with the emergence of the growing capabilities of information technology (IT) to enhance the teaching and learning process. The Initiative looks at the role of IT in the Learning Transformation and its ability to position the United States and its businesses to compete more effectively in the global economy.

Broad updated members on the work accomplished to date by Ken Kay (Project Consultant for the Initiative, Infotech Strategies) and his group. This work comprises a set of draft research papers that members of the working group have been developing:

- Definitions of learning transformation—What does it mean to enhance learning productivity? What are the characteristics? How does IT contribute?
- Barriers to the improvement of learning productivity.
- Best practices—six to eight examples of how IT has been effectively used with demonstrable results.
- International investments—what other countries are doing in terms of investments in education using IT.

It is expected that the work will be concluded by December 2002 with a set of "actionable" recommendations—actionable by business, higher education, and elected officials at the federal and state levels of government.

The Summer 2003 Meeting in Washington, DC, will provide a good opportunity to participate in the public policy process on the issues raised by the Learning and Technology Initiative report.

Sean Rush

Sean Rush walked members through the set of slides presented by Ken Kay at the working group session.

He outlined the objectives of the Initiative as a way to challenge traditional notions of learning and achieve more positive learning outcomes, and to accomplish more effective education and a greater ability to assess that education. These goals encompass a view of how learning takes place from pre-K–12, to higher education, corporate education, training, and professional development—that is, almost a pre-K through age 80 view.

The work of the Initiative will look at how best to use IT to achieve these goals, positioning higher education as the key player in the learning transformation process.

Rush outlined the **five major contentions** used as the starting point for Learning Transformation and the Role of IT:

- For the United States and its businesses to remain competitive and bring the best opportunities to its citizens, learning must be transformed.
- U.S. education has the potential to address the country's education needs through learning transformation.
- The best way to ensure that learning transformation can address U.S. educational needs is to make appropriate use of IT.

- Higher education plays a unique role in achieving learning transformation and ensuring that IT is used appropriately to improve U.S. education.
- The United States must address significant challenges to reach the full potential of learning transformation with IT.

Barriers to successful education were identified. These include:

- Organizational barriers.
- Content and relevance.
- Lack of interaction.
- Lack of individualization.
- Inflexible access.
- Lack of clear objectives.

Rush continued by outlining six successful approaches to overcome these barriers. These approaches resulted in the Transformation of Learning *(see Figure 3)*.

Without the use of IT, however, implementing these approaches to achieve learning transformation raises significant resource implications that would surpass the means of educational institutions.

Rush highlighted a quote by Carnevale and Descrochers on the need for educational changes in order to sustain competitiveness: "Absent reforms that allow us to produce and distribute education cheaper, faster and better, we may not be able to afford all the education we need to maintain our competitive position or to reduce the widening gap in earnings between the most and least educated."

Rush went through the ways that IT can facilitate learning transformation, based on the implementation of the six approaches identified above. He concluded by emphasizing that the Initiative was not about IT but about Learning Transformation achieved best through the use of IT.

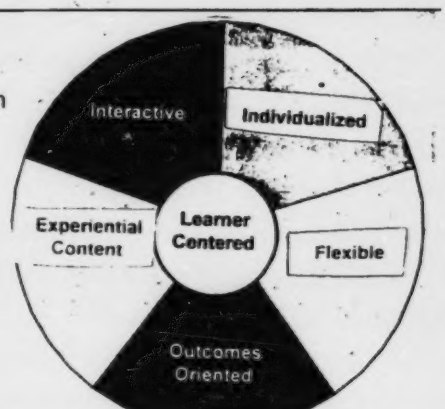
Molly Broad concluded the presentation by informing the Forum that resources raised to date had been used effectively and that the schedule until December 2002 had been firmly set with two site visits, one to Nebraska and one to Arizona, to talk to people whose work had been described in the Best Practices working paper and to ask for a critique of the work in progress. The work would be wrapped up with a set of recommendations and completed by early December. Broad highlighted the need for additional funds to complete the project.

A discussion with members in the audience followed, during which several people raised the issue of the digital divide, highlighting access limitations for certain groups of populations. Members were referred to the Forum's report, *Spanning the Chasm,* as drawing the link to the set of characteristics discussed in the Learning Transformation document. It was made clear that the report should focus on improving learning and education through transformations that achieve better educational outcomes, rather than focusing on productivity. While the report is clearly meant to cover the issue of improving learning, audience members raised concerns about placing too much emphasis on IT.

FIGURE 3
Learning Transformation
These approaches result in learning transformation

The six approaches that define learning transformation are:

- Learner-centered.
- Experiential content.
- Interactive.
- Individualized.
- Flexible.
- Outcomes oriented.



Source: Prepared by Diana Oblinger, 2002, for the BHEF Learning Transformation Initiative.

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Math and Science Education—Toward a Systemic National Leadership Program

The View from Academe and Government

Warren Baker (President, California Polytechnic State University) introduced Joseph Bordogna (Deputy Director and COO, National Science Foundation) as the most "effective person in Washington, DC, in bringing agencies together to work for a common purpose."

Warren Baker

Background

Baker laid the groundwork for the discussion by pointing out that math and science were "inextricably bound to the economy of the country....According to recent National Science and Technology Council reports, science and technology have generated about half the productivity growth that the United States has enjoyed in the last 50 years." The Department of Commerce estimates that the IT industries alone had contributed more than one-third of the growth of real output for the overall economy. He explained that while the technology sector had been suffering sharp declines, in the long run it was an important element in the economic competitiveness of the country. Citing *A Nation at Risk*, he emphasized the lessons learned from the inadequacy of science and technology education and capabilities.

Gap in Demand and Supply

Baker gave a snapshot of the employment market in the science and engineering fields, saying that the demand in those fields was strong, with a projected growth in employment of 50 percent, almost four times the rate of other occupations, coupled with a high rate of retirement in that sector.

He noted that in the face of a rising need for science and engineering workers, the performance of the nation's K–12 students in math and science continued to lag behind that of their peers in other countries. Public colleges and universities also fell behind in the education of graduates in science, mathematics, and engineering, he added. Referring to the Third International Mathematics and Science Study (TIMSS), he pointed out that while the youngest U.S. students were competitive internationally, the performance of middle school students lagged behind their international peers in math, and high school students lagged behind in both math and science. According to a presentation by the National Alliance of Business (NAB), a repeat of the TIMSS study in 1999 among eighth graders confirmed that U.S. students, in comparison to their international peers, performed more poorly as they entered higher grades *(see Figures 4 and 5 on pages 30–31).*

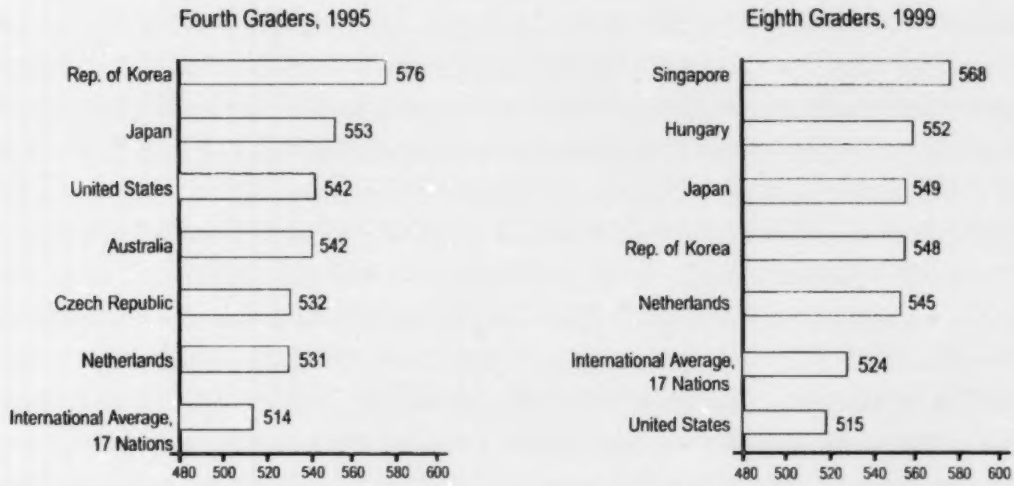
And, while total baccalaureate enrollments and degrees have increased during the past decade and a half, bachelor's degrees in science and engineering have stagnated, even declined, except in the area of biosciences. According to the NAB presentation, today Asia and Europe each produce more science and engineering first degrees than all of North America.

Lack of Access to Minorities

Baker also pointed out that despite the growth in diversity of the U.S. population, minority student participation in achievement tests in math, science, and engineering continued to lag behind overall national averages. He further referred to a recent study showing that in California—where one in every two kindergarten students is of Latino background—only 12 percent of Latino ninth graders had taken the courses required to go on to public

FIGURE 4

Progress of U.S. Students Between Fourth and Eighth Grade in Science as Compared to Their International Peers: 1995 and 1999



Source: U.S. Department of Education, National Center for Education Statistics. Initial Findings from the Third International Math and Science Study–Repeat, December 2000.

universities, and more than half of those students required some form of remediation. These trends were amplified by low participation rates of underrepresented minorities in science and engineering, he added.

The H-1B Visa Program

Baker explained that as a result of these domestic educational trends in recent years, industry had been forced to recruit science and engineering workers from other countries. He emphasized that in California, one in six engineers and more than one in five computer and math scientists were non–U.S. citizens. The H-1B Visa program was seen as a "temporary" solution to the gap problem, Baker explained, that raised growing concerns from many executives about technology transfer issues.

Baker spoke of "tremendous social unrest" if the trend continued with insufficient numbers of U.S. students being prepared for "important, challenging, and well-paid jobs" in the science and engineering fields.

He emphasized that "scientific literacy" was important not only for the development of efficient public officials serving the nation's democracy but also as a "discipline of the mind" for individuals in their private and professional lives.

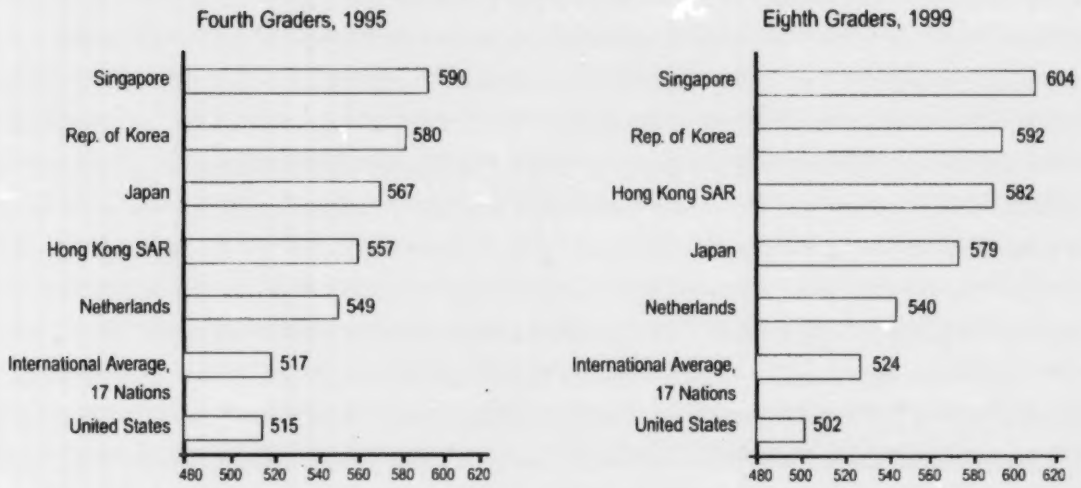
The Importance of Teacher Quality

Baker pointed out that the weak performance of students in the fields of math, science, and engineering was correlated in important ways with the quality of instruction and the qualification of the teaching workforce. Referring to the NAB presentation based on the TIMSS, he reported that the content quality of eighth grade science and math programs in the United States ranked relatively low in comparison to other developed nations *(see Figure 5)*. The study further showed that many high school math and science teachers were not well prepared and that many of them had not even earned a minor in the field. Furthermore, a 2000 report by the U.S. Department of Education showed that:

- 28 percent of math teachers in low-poverty schools lack even a minor in math.
- 40 percent of math teachers in high-poverty schools lack even a minor in math.
- 14 percent of science teachers in low-poverty schools lack even a minor in science.

FIGURE 5

Progress of U.S. Students Between Fourth and Eighth Grade in Math as Compared to Their International Peers, 1995 and 1999



Source: U.S. Department of Education, National Center for Education Statistics. Initial Findings from the Third International Math and Science Study–Repeat, December 2000.

- 20 percent of science teachers in high-poverty schools lack even a minor in science.

Baker concluded by emphasizing the importance of "seamless transitions" in the educational system and efforts needed, particularly during the early years of baccalaureate programs to overcome the tremendous rates of attrition—as high as 66 percent in a number of engineering schools in California.

The next topic of discussion was ***how to bring greater national attention and a greater sense of urgency to the important work of preparing our students for science and engineering studies and careers.***

Joseph Bordogna (Deputy Director and COO, National Science Foundation) gave a strategic picture of what the National Science Foundation (NSF) and the U.S. government are investing in regarding math and science education.

He commended the Forum's work on the Learning and Technology Initiative, specifically referring to the role that IT played as a tool in learning transformations. He underscored the importance of considering not only IT but other technologies as well. Bordogna encouraged the Forum to pursue collaborations with all players involved in improving education in the United States.

Joseph Bordogna

National Science Foundation Investments

Bordogna outlined the ways in which NSF was investing its resources. $5 billion was broken down into the following areas: $1 billion in educational activities, $1 billion in tools, and approximately another $3 billion in research. The strategy is to keep these areas of investments linked, he pointed out. "NSF does not have any laboratories, we support others to do things," he explained. "We invest in the efforts of others." He highlighted approximately 10 other federal agencies that supported R&D, most of which also supported graduate student fellowships and traineeships. However, while all these agencies procured research results, NSF was said to "integrate

research and education," Bordogna explained, "it is very, very different; we don't go buy research results, we don't go buy discovery for a purpose other than integrating it with education....No money goes out from NSF for research unless somebody is getting educated at the same time." He added that the issue also addressed the basic premise behind Learning Transformation.

The Strategic Vision of NSF

Bordogna told members about changes that had occurred three years ago in the way the federal government operated regarding the budget. Now, along with the budget, he explained, there needs to be a strategic plan (renewable every three years), an annual performance plan, an annual performance report, and a financial statement.

He described the NSF strategic plan as "simple and straightforward." It includes:

- **A vision:** "Enable the nation's future through discovery, learning, and innovation." NSF is committed to playing its part in "enabling others to do their work," Bordogna said.
- **Three goals:**

  People—to enable a diverse and competitive "world-class" science and engineering workforce (NSF invests from pre–K through post-doc and even to early development of faculty).

  Ideas—to enable discovery.

  Tools—to enable the scientists and engineers to do their work.

When speaking of tools, Bordogna reiterated his comment that IT played the role of a "driver," influencing and driving the learning transformation. As tools are becoming more expensive, it is important that they be "shared," he emphasized, referring to the notion of "accessibility." He pointed out that *accessibility* was part of the strategy and that all players needed to have access to the tools, which represented a considerable increase in the budget.

The Strategy

Bordogna explained that NSF did not "keep funding things forever." When a frontier is breached, money is moved to a new frontier, and so on.

He outlined the three questions asked when considering a project:

1. Is this project an investment in intellectual capital?
2. Does this project integrate research and education?
3. Does this project promote partnerships?

Bordogna pointed out that NSF outreach to minorities was a requirement whenever money was received; he referred to "embedding diversity," with accessibility and outreach. When considering major investments, NSF's special management review board asks two overarching questions: "Are you connected to K–12?" and "Are you worried about diversity?" Diversity needs to be embedded in all educational activities, he explained, referring to the work of the Alliance for Minority Participation (AMP), which Luther Williams (Director of Education, Missouri Botanical Garden) presented at the Forum's 2002 Winter Meeting (see spring 2002 issue of *Forum Focus*).

Ongoing Projects

Bordogna outlined examples of NSF projects that could benefit from the Forum's collaboration:

☐ Fast Track Kids to PhDs—a program that aims to generate a pool of PhD students.

☐ Proposals under the NSF Math and Science Partnership—a partnership between the Department of Education and NSF, in which NSF received the Math and Science K–12 Education portion of the *No Child Left Behind Act* signed by President Bush in January 2002, with $200 million per year for five years. Strategically, the partnership focuses on two goals:

1. Work to create a partnership between the university and K–12 systems.
2. Encourage K–12 school teachers to become more "enabled."

☐ **Grants for Fellowships**—approximately 900 fellowships are awarded every year to baccalaureate Graduates (G) who can use them anywhere in the country for PhD programs. About 300 more fellowships, called GK–12 fellowships, were recently added. These include a full year of 20 hours per week spent in a K–12 school system near the university. This academe-K–12 partnership is meant to bring support to the teachers rather than to take over, Bordogna explained.

☐ **Research Experience for Teachers Program**—NSF grant beneficiaries can obtain supplemental money for bringing teachers into laboratories. The program not only connects to K–12, it also "enables" the teachers.

All such programs support and integrate the notion of Learning Transformations in which the Forum is interested, Bordogna emphasized. He spoke about the new "cyber-infrastructure" that NSF is currently working on, underscoring the importance of creating an infrastructure that is accessible to all, with all citizens being connected to the World Wide Web.

Lee Stiff

The Science of Learning Centers

Bordogna concluded by highlighting a new NSF initiative soon to be announced: the Science of Learning Centers, or SLCs—a partnership among a variety of disciplines and organizational entities to develop a knowledge base on how people think and learn that can be used in all facets of society. Each center will have a budget of $5 million per year for 10 years and will be organized in a fashion similar to NSF's Engineering Research Centers (ERCs), Science and Technology Centers (STCs), and other types of centers that focus on integrating research and education; as with the ERCs amd STCs, they will be merit-based and represent a valuable source of recruitment for companies—for example, 800 companies are currently involved with the approximately 21 existing ERCs.

"Nobody knows how people think and learn," Bordogna emphasized. "We have some ideas," he added, "but in order to build a rational pedagogy for K–12 education, for example, we need a knowledge base for how people think and learn." NSF "likes to work with everybody," he said. Finally, he urged the Forum to communicate with the Council on Competitiveness to learn about its initiative called Building Engineering and Science Talent (BEST). Approximately $10 million will be spent on a program that provides a comprehensive understanding of what Best Practices for Math and Science education can be found and synergized around the country.

Lee Stiff (Immediate Past President, National Council of Teachers of Mathematics Studies and currently a Professor at North Carolina State University) was invited to address the Forum.

Background

Established in 1920, the National Council of Teachers of Mathematics is an organization of pre-K–12 teachers and college professors, supervisors, and administrators, serving more than 100,000 members.

In 1989, the Council created math education standards—pursuant to a 1980 document—using its own funds (no federal funds were involved).

Stiff referred to the results of the TIMSS Study showing the poor performance of students in the fields of math and science *(see Figure 5 on page 31)*, pointing out that in the First and Second International Studies, students had performed even more poorly.

While an increase in performance rates had occurred, performance had not reached an adequate level of competitiveness for American students. "The traditional mathematics and science that were taught in schools for so many years were not serving the masses of young people, and that is why some changes were being made," he said, adding that this was the reason why the First and Second International Studies did not show the kinds of success wanted by the United States. The Council thus created standards to try to redirect efforts in schools to improve results.

In the 1960s and 1970s, the goal of science and mathematics instruction was to "serve the few," said

Stiff. "Today, the challenge is not to educate the few, but to educate the many," he continued, explaining that in order to do so, things needed to be done differently. He emphasized that scientific literacy should not be aimed exclusively at producing mathematicians, engineers, or scientists; it should be aimed at "educating the many."

Focus on Content

Referring once again to the results of the TIMSS, Stiff pointed out that only three countries in the world did not have a national curriculum in math or in science, the United States being one of them—various U.S. states have different curricula.

"If you know what it is you want to do, you have a better chance of doing it," he said. He reiterated the issue of "teacher quality," which Baker introduced earlier, emphasizing the need for teachers to understand the content before thinking in terms of pedagogy.

A National Curriculum in Math and Science

Stiff stated that the United States needed a national curriculum in math and science, pointing out that the United States was proceeding "backwards" by having test results drive content. Currently, the U.S. system is based on testing at the state level; a nationwide test would require defining the content nationally. Stiff urged Forum members to engage in a dialogue about the importance of a national curriculum. "If we could agree on what it is that we want young people to learn, then we probably can deliver it," he said. This would then make it possible to correct the "teacher quality" situation, by having math and science specialists teach pre-K–5 as well as middle and high school teachers with majors in those areas.

Business leaders recognize that in order for the U.S. economy and businesses to be successful, more individuals with strong mathematics, science, and technology skills are needed, but "you cannot teach the masses the way you teach the few," Stiff said. Two changes are needed, he concluded: a national curriculum and qualified teachers in classrooms.

Dennis Smith and **Bob Jones** guided a discussion with Forum members on the issue of a ***National Systemic Approach to Changing Math and Science Education.***

Dennis Smith opened the discussion on the "View from Academe and Government," by highlighting that a few years ago, the National Academy had tried to create a national curriculum in biology but that unfortunately, virtually no one knew about the work. Referring to the AMP—the most successful program, with 200,000 students—he pointed out that the program did not exist in every state in the nation. "If it did, it would turn out 2 million students," he said, "if we made it a systematic approach and had the financial resource base to support such an approach."

Smith hoped that members would continue to believe that the Forum could still make a major impact at the national level, even though there were many other different ongoing programs. By taking the programs that worked and identifying why they worked, it would be possible to turn them into a systemic approach to changing math and science education, both in the training of teachers as well as of students, he added.

He expressed great satisfaction with the Bordogna and Stiff presentations and told members that these could serve as the road map for how the Forum should proceed. Members emphasized that accountability was still key to the success of the approach. Concern was raised about the fact that a systemic approach would serve only the students who were still in the system. Efforts were needed to reach parents and students who were not "in the system." It was proposed that the Forum look into the possibility of a long-term (10- or 20-year) outreach campaign.

There was also a strong belief in the impact that the Forum could have on the state legislatures, which could play a key role in the creation of a systemic approach at the regional level.

The View from Business

Randy Smith (Executive Vice President, Tenet Healthcare Corporation) moderated the second part of the panel, "The Business Perspective." Smith referred to comments made by Craig Conway (PeopleSoft) at the Forum's Winter 2002 Meeting on the issue of solving the demand and supply for science, math, and engineering talent by hiring foreign nationals to fill the U.S. high-tech jobs. He echoed the concern raised by Warren Baker in his presentation about the loss of intellectual property as a result of using the H-1B visa programs to solve the problem.

Randy Smith

Smith explained that in the health care industry, particularly the hospital industry, there was a growing demand for professionals with a background in math and science. With baby boomers aging and demands for health care services increasing, the need for professionals with science and math-based K–16 experience also is increasing, he said. More than ever now, there is an increasing need for critical thinkers and analytically oriented leaders and managers, Smith explained, with the global economy raising the bar for the skill sets of these professionals.

Smith introduced the speakers, Dave Swain (Senior Vice President, Engineering, Boeing Company) and Ed Shonsey (President and CEO, Syngenta Seeds, Inc.).

Dave Swain presented a viewpoint on the demand for—and the broad carrier fields requiring—basic competence in math and science, as well as the critical thinking skills associated with learning math and science. He started by giving members a broad picture reflecting the changes that were occurring in the world as we move to a more global economy. He highlighted four characteristics: (1) security and safety; (2) natural resources; (3) capital resources; and (4) productive workforce. For each characteristic, he indicated the mid-20th century specifics and compared them to the mid-21st century. For example:

Dave Swain

- Security and Safety. In the 20th century, these federally provided services were nationally based; in the 21st century, they are becoming globally based, with more and more alliances being formed to protect the nation's security around the world.
- Natural Resources. They are moving from locally available to globally available in the 21st century, with transportation costs decreasing.
- Capital Resources. They are also moving from locally based venture capital to global investments around the world.
- Productive Workforce. In the mid-20th century, workers were manually skilled; they were craftsmen. In the 21st century, the workforce has become more highly educated, driving the economy. "Being global brings challenges and competition for our citizens," Swain pointed out.

Swain then outlined the "economic drivers" in the economy:

- Computing.
- Business.
- Engineering.

He highlighted the fact that these fields required more than high school mathematics. He presented 1998 data on percentages of graduates across the country—with approximately equal participation of males and females—with calculus, pre-calculus, chemistry, physics, and both chemistry and physics showing pre-calculus (the norm to enter a good program) at 20 percent and both chemistry and physics at a little more than 20 percent. Looking at participation by ethnic group in calculus and pre-calculus, participation was uneven between groups, with Asian Americans at a little more than 40 percent in pre-calculus compared

to African Americans at less than 15 percent. How do we explain such dramatic differences when students of various backgrounds are attending the same schools? Swain mentioned several points: cultural differences, parenting differences, expectations. One needs to worry about these data when thinking about the country's future pipeline, he pointed out.

Swain then showed a "conceptual diagram" illustrating how "America will need an even higher quality workforce to compete." He underscored that by 2050, there will have been a dramatic increase in the number of "intellectual workers" from the current developing world, which comprises countries such as India and China. "The world's intellectual workforce is growing at a faster rate than the G7," he pointed out. This will cause large industries to move to where the most productive talent is, and where costs to set up plants are lowest. This situation should raise concern among the nation's citizens. "If our workforce isn't more skilled, it is a threat to our overall economy," Swain highlighted. This means that in order to compete, America will need an even higher quality workforce:

- Multinational companies will go where the intellectual capital is and leverage those resources globally.
- Societies without strong intellectual capital will not participate in world economic growth.
- Quality of life will erode in those societies that do not have the proper intellectual capital.

Swain highlighted the importance of an "integrated solution." Technical work must be seen as a great profession. Unfortunately, a major portion of America's population does not see it this way. The people in the field must be respected broadly, he added; the technical workforce is not being held up as the role model in America. "Government, industry, media, academe must all be part of the solution," Swain emphasized. He pointed out that math and science must be seen as a requirement, not just for the 20 percent of students who major in math and science, but for all students. "Teachers need to be supported and respected," he said, explaining that parenting needed to be part of the integrated solution. A holistic approach is needed, and the Forum could play a role in building such an integrated approach, he concluded.

Ed Shonsey gave a Life Science Company perspective on the idea of a ***National Systemic Approach to Changing Math and Science Education.*** He outlined the challenges that Syngenta was facing in having math and science take technology transfer to the marketplace. While one-third of the company's employees have PhDs, one-third have high school diplomas or less, and all others are somewhere in between, 100 percent of the company's employees are required to use math and science in their daily work, he explained.

Overview

- The company currently invests $3 million every day of the year, part of which goes into training and retraining.
- One million yield test plots are conducted per year with five to 20 different data points for each plot. This involves not only PhD scientists, but also employees without a high school diploma.
- More than 300 environments are tested to determine differences between genetics and the environment.
- The company runs in excess of 10 million marker data points per year; lab work later needs to be related to field data. Field workers and PhDs work side by side to accomplish this approach.
- A computer grid network of more than 2,000 computers to interconnect databases was created.
- 160,000 customer databases exist, with 60 percent linked to the company via the Internet.

Challenges

One of the company's biggest challenges is developing and retaining expertise, Shonsey pointed out. While the company "customizes" its employees' knowledge and experience, employees eventually may go off to a more attractive business. These skilled employees know that they are in high demand and can therefore move from one business to another based on salaries. At the same time,

Shonsey explained, the company is lacking PhD plant breeders. "We can't find enough of them in order to complement what we have to do to find the new discoveries," he said.

New Needs

The company is now challenged with the need for expertise in:

- Genomics.
- Bio-informatics.
- Pathology, cell biology, entomology, biochemistry.
- Nanotechnology.
- New customers require "Amino Acid Profiles" that will revolutionize the cost infrastructure and the effectiveness of a particular product.
- Statistics: the lifeblood of genetics.

Shonsey highlighted that many of these skills are not yet fully present when students come out of college, resulting in the need for the company to complete the necessary training and education.

U.S. Observations from 120 Countries and 14 Global Managers

Shonsey collected opinions from a number of non–U.S. managers in the company who had had siblings in the U.S. educational system who had later returned to their countries. These opinion questions included, "What is right or wrong about the way we in the United States are educating your people?"

Observations from non–U.S. students included:

- "Science and math are hard." Cultural issues and the adjustment of the level of testing were mentioned.
- There are lots of programs, but kids labor in obscurity. "It must be cool" in order for students to be attracted.
- Parents have to back this and understand the value of math and science. "College education easily outstrips the family wallet."
- Kids, similar to the rest of us, follow the money.
- "Americans don't really know just how far behind we are."
- Make it an international issue of honor. "It works for hockey, why not chemistry?"

Shonsey then identified six needs:

1. Balance math and science education in the United States. It is currently too one-dimensional. "It requires both imagination and reason."
2. Understand that it is not an issue of "right versus wrong"; it is a study of patterns.
3. Raise the bar: A multiplicity of models to shape diverse paths is needed.
4. Motivate: Force change via incentive programs and curriculum.
5. Create a supportive work environment: Math is not only for "nerds" or loners. Focus on learning together versus in isolation.
6. Ride close herd: Encourage mentoring, facilitate networking, showcase results. Everyone must deal with it, so provide the opportunities.

Shonsey concluded with a quote from mathematician Wierstrass: "It is true that a mathematician who is not somewhat of a poet will never be a perfect mathematician."

Comments and Questions from Audience

Augie Gallego (Chancellor, San Diego Community College District) touched on the problem of high-poverty, high-minority schools suffering from high numbers of inexperienced teachers. He addressed the myth that parents of underrepresented school children are not concerned about their children's education and future. Language is the main barrier blocking these parents from communicating with school boards and principals; they are in fact very "passionate about their children's future," Gallego underscored. "We need to find ways to engage them in the teaching-learning process." He also commented on studies conducted by community colleges on the teaching and learning of algebra. Results showed that courses in algebra were the ones that were the most offered, the most failed, and the most repeated. He also pointed out that two-thirds of the California State University graduates had experienced community college in some way. In the University of California system, one-third of graduates were said to have had a community college experience. Changing math and science education involves many different issues, Gallego

explained, highlighting politics, the issue of immigrant families, and labor-based barriers.

Bob Jones

Lou Tornatzky (Senior Fellow, Southern Technology Council and Senior Scholar and Vice President for Research, Tomás Rivera Policy Institute) spoke of the lack of understanding about the importance of dissemination. He gave the example of a three-year project that was part of an NSF initiative on the IT workforce as it pertains to the Latino community. Several dozen large projects have been funded across the country, resulting in new models to increase the percentage of minorities and women in technology-related careers. Overall, these projects lacked the required dissemination to reach the key players (i.e., the teachers).

Lee Stiff (National Council of Teachers of Mathematics) reiterated that the best systemic approach was to integrate math and science from day one into the school systems, thus making it a national matter. He encouraged the Forum, particularly with leadership from the business community with its influence on political leaders, to convey the message that a national change is needed. He invited members to visit the NCTM web site at www.nctm.org, where many initiatives for making mathematics accessible to more young people can be found. If members found theses initiatives to be reasonable, Stiff asked them to be supportive.

Members exchanged their views on how to go about changing math and science education by implementing a national systemic approach.

Bob Jones (President and CEO, National Alliance of Business) concluded the discussion by underscoring that the number one fundamental issue is that policy makers in both Congressional and state legislatures, the press, and the public "have no clue" of what is happening in the rest of the world and its impacts on innovation and the quality of life in this country. "The fundamental issue of what is happening out there in the rest of the world and what its impacts are on Americans individually is not produced in the press, not discussed in the Congress, not discussed in public at all."

The underlying issue of "education for the many" versus "education for the few" is a fundamental shift, Jones added. "It is not understood by policy makers nor by the public," he said. He pointed out that since the timing was right, with the national debate to put the metrics in place to manage the education system having occurred, proceeding to the next phase was appropriate, with business and academic leaders standing up on the issue. If universities expect all students coming into their institutions to have certain levels of preparation, they need to make the necessary requirements. If, as expected, the SAT and the ACT became competency-based math tests, this would take changes in the curriculum back into the system, Jones explained. Having a "flat" requirement that would drive the issue back to kindergarten and first and second grades represents a fundamental issue. One half of the Forum's agenda could be for business and academic leaders speaking to the country to call attention to the fundamental shifts that are necessary to move ahead. Jones echoed Lee Stiff's suggestion of embedding math and science preparation from grade one all the way through the system. The current mentality regarding math and science needs to be changed; there is a general feeling of fear about math and science that needs to be removed, Jones explained. The way to accomplish this is to integrate math and science from the beginning so that children do not even realize they are taking it.

Concluding Remarks and Next Steps

Ed Rust (Forum Chair) concluded the session by highlighting the opportunity the Forum had, under the leadership of Bob Jones and Dennis Smith, to pursue the Math and Science Initiative. He underscored the need for action plans and for driving results as the next steps in this effort. He encouraged taking the momentum that came out of the group in this effort and moving it forward.

He extended his compliments as well as the organization's gratitude to Dennis Smith for his leadership during the last two years. He thanked Molly Broad and the University of North Carolina, as well as Bob Ingram and GlaxoSmithKline, for hosting the meeting. He expressed great honor in having been entrusted with the chairmanship of the Forum and thanked Dennis Smith, Hank McKinnell, and Dennis O'Connor. With Mark Wrighton as Vice-Chairman, Rust expressed confidence in keeping the momentum going and building on the success of the Forum. He thanked the Sister Forums from Japan and the United Kingdom for participating in the meeting.

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William H. Danforth
(1992–1994)
Chancellor
Washington University

*Titles and affiliations reflect positions held at the time of the meeting.

Rust described the sessions on *Nursing, How Students Are Paying for Education, University Outcomes, and Regional Economic Development* as generating fruitful discussions that benefited from the insight and input of Forum members. He underscored the importance of educating one another within the Forum and explained that while some of the issues raised would not be undertaken as initiatives, these issues could benefit from collaborative discussions on an ad-hoc basis. Other issues would be appropriate for additional study and the production of research papers, Rust explained, with the possibility of leading to public discussions. These require identifying effective ways of communicating key messages, he added. Through the shared interests in collaborative efforts, the organization builds on differing perspectives from its members, a critical component of the Forum's success. Rust closed the session by highlighting the great opportunity the Forum had through its resources and leadership to "invent the future."

2003 WINTER MEETING

JANUARY 30 – FEBRUARY 1, 2003
La Jolla, CA

Co-hosted by Augie Gallego
(Chancellor, San Diego Community College District)

The agenda in San Diego will include sessions on:

- A national leadership agenda on creating a systemic math and science education program (new working group, Smith/Jones).
- Community college program, based on Augie Gallego's role in the San Diego Community College District.
- University Outcomes and the Workplace (new working group).
- Learning and Technology—going public with the final product (Initiative working group report and decisions).
- Regional Economic Development—Georgia case study.
- Presentation on SAT/ACT and discussion on downstream implications.

The Business-Higher Education Forum, a partnership of the American Council on Education and the National Alliance of Business, is a membership organization of chief executives from American businesses, colleges and universities, and museums. Founded in 1978, the specific goals of the group are to increase communication among the sectors, analyze issues of mutual concern, and deliberate on courses of action that will effect change in these areas.

Higher education and business are increasingly interdependent—educational institutions develop the human resources that corporations apply to the production of goods and services. Throughout its history, the Forum has addressed this interdependence by focusing on issues in which cooperative efforts can yield positive results for these sectors. As such, the Forum is addressing the critical issues of improving K–16 education, promoting minorities in the workforce, and enhancing research collaborations.

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